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A STUDY OF THE RELATION OF FAMILY INCOME AND OTHER ECONOMIC FACTORS TO PELLAGRA INCIDENCE IN SEVEN COTTON-MILL VILLAGES OF SOUTH CAROLINA IN 1916.[1]

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In the spring of 1916 we began a study of the relation of various factors to pellagra incidence in certain representative textile-mill communities of South Carolina. On a varying scale the study was continued through 1917 and 1918. The results of the first year's (1916) study with respect to diet,[2] to age, sex, occupation, disabling sickness,[3] and to sanitation[4] have already been reported. At the present time we wish to record the results of the part of the study dealing with the relation of conditions of an economic nature to the incidence of the disease.

I. REVIEW OF LITERATURE.

A close association of pellagra with poverty has been repeatedly remarked upon since the time of the first recognition of the disease. In the earliest account, Casal (1870, p. 93), discussing the diet of those persons attacked by the disease, remarks that "they eat meat very rarely since most pellagrins are poor field laborers, and this circumstance does not permit them to eat meat daily nor even from time to time." Continuing, he says: "Their only beverage is water. Their clothes, beds, habitations, etc., are strictly in keeping with their extreme poverty." Further along, discussing the treatment of the disease, Casal states that "milk, thanks to the butter it contains, is certainly capable of supplying the nutritive lack of the other foods; they use it but rarely without having first removed the butter, since these poor people sell the butter in order that they may be able to buy other necessaries, thus using in their own diet what remains in the milk after having thus treated it."

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[1] From Field Investigations of Pellagra. Submitted for publication Aug. 31, 1920.

[2] Goldberger, Wheeler, and Sydenstricker, 1918 and 1920*a*.

[3] Goldberger, Wheeler, and Sydenstricker, 1920*b*; Sydenstricker, Wheeler, and Goldberger, 1919.

[4] Goldberger, Wheeler, and Sydenstricker, 1920*c*.

Much more definite and direct is Strambio (1796) who states that "thus much is certain, that pellagra is most at home where poverty and misery reign and increases as they increase."

Very interesting and significant is Marzari's observation.[5] "I have several times observed," he states, "that if a villager falls into poverty, as happens so often as a result of a storm, drought, or other calamity, pellagra does not fail to crown his misfortune and put an end to his miserable existence."

Holland (1820), in introducing his discussion of the cause and symptoms of pellagra in a paper read in 1817, based on observations of his own and on information secured from Italian physicians in the course of a journey to Italy, remarks: "The pellagra is a malady confined almost exclusively to the lower classes of the people, and chiefly to the peasants and those occupied in the labors of agriculture." He repeats this two or three times in other connections. In his discussion of the etiology of the disease (p. 322) we find the following highly suggestive statements: "Though I have spoken of Lombardy as one of the most fertile portions of Europe, yet to those who consider the little certain relation between mere productiveness of soil and the prosperity or comforts of the population dwelling upon it, it will not appear very extraordinary that the peasants of this district should be subject to various physical privations unknown to the people of countries which are much less favored by nature. The fact unquestionably is, whatever be our speculations as to the cause, that the peasants of Lombardy do for the most part live in much wretchedness, both as regards the quantity and quality of their diet and the other various comforts of life. It further seems probable, if not certain, that this evil has been progressively augmenting within the last 50 years; partly, perhaps, an effect of the wars which have so often devastated the country by marches and military contributions; partly a consequence of the frequent changes of political state; together with the insecurity, the variable system of government, and the heavy taxes and imposts attending such changes. To these causes may be added a decaying state of commerce and a faulty system of arrangement between landlords and the cultivators of the soil, all tending to depress agriculture and to reduce the peasantry at large to a state of much misery and privation." Continuing this discussion, Holland remarks further (p. 333): "Animal food rarely forms a part of their diet, and although living on a soil which produces wine their poverty almost precludes the use of it, even when sickness and debility render it most needful. The same condition of poverty is evident in their clothing, in their habitations, and in the want of all the minor necessaries and comforts of life. The immediate effect of these privations is obvious in the aspect of squalid wretchedness and emaciation which forms so striking a spectacle at the present time throughout the greater part of Lombardy. I say particularly *at the present time*,[6] because whatever may have been the progress of misery among the peasants of this country during the last half century it appears to have increased in a tenfold ratio during the last two years, the effect of bad harvests added to the preceding wars and political changes which have distressed this part of Italy."

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[5] Cited by Russell, 1845, p. 167.

Hameau (1829), in the first recorded observations of pellagra in France, reported that "this disease attacks individuals of both sexes and all ages, but I have not yet seen it in any but the poor and uncleanly who subsist on coarse food."

Lalesque (1846), in his account of pellagra of the Landes, cites a number of instances illustrating the conditions of misery under which pellagra occurred, finally exclaiming (p. 421): "These are the individuals attacked by pellagra, for it attaches itself to poverty as the shadow to the body."

In a discussion of pellagra in Gorz-Gradisca, Berger (1890) very significantly observes: "The appearance during the last decennium of diseases of the vine, the reduction in value of the product of the soil because of foreign competition, crop failures, increase in taxes, increasing living costs, all operated to undermine economic conditions, particularly of the poorer country folk, and thus prepared favorable conditions for the spread of the disease."

Discussing the therapy and prophylaxis of pellagra in Bessarabia, V. Rosen (1894) bewails the attendant difficulties "in that, on the one hand, the alimentation with cornmeal porridge is a deeply rooted national custom, and, on the other, that the disease attacks the poorest class of the population; 'N'am vaca, n'am lapte a casa' ('I have no cow and no milk in the house') is uniformly the reply of the patient to questions in relation to this subject," and Sofer (1909, p. 219), discussing the economic status of pellagrins (in Austria), remarks that "89.9 per cent haven't even a cow."

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[6] Italics in original.

The extremely unfavorable economic conditions of those subject to pellagra (in Austria-Hungary, at least), is further strikingly suggested by the character of some of the recommendations for its control. Thus Von Probizer (1899, p. 141) urged, as a necessary measure, "pecuniary aid by the Government in view of the deplorable condition of the peasantry in the affected localities."

V. Babes (1903), writing on pellagra in Roumania, remarks (p. 1187) that "practically all pellagrins are very poor;" and goes into some detail in describing the unfavorable economic condition of the Roumanian peasant, which leaves him in debt to the landowner and the tax collector.

In modern Spain we have Calmarza (1870) remarking (p. 66) that although he had seen cases in well-to-do individuals, the disease only exceptionally occurred in those of this class. He adds (p. 67) also that in his experience, unlike the reported observations of others (Roussel, 1866, p. 431), pellagra is quite common in beggars. In discussing the etiological rôle of widowhood, this keen observer expresses the opinion (p. 68) that this plays a part only in proportion as it tends to bring about a depression in economic well being and a consequent insufficient alimentation. Huertas (1903) describes the disease as occurring among the most miserable class of the population of Madrid, who live on the food picked from the city's garbage.

In Egypt Sandwith (1903) found the disease highly prevalent among the poorer peasants of Lower Egypt. "In one village," he reports, "where the inhabitants are especially well to do because they get regular pay throughout the year from the Domains administration, there were only 15 per cent of pellagrous men, while among the men of the village, which has the reputation of being the poorest, the percentage rose as high as 62."

Gaumer (1910), discussing pellagra in Yucatan, states that the disease did not become epidemic in that State until 1884, two years after a destructive invasion by locusts or grasshoppers. "Among the better classes the disease seldom made its appearance. * * * It was the middle and lower classes who, from reduced circumstances, were obliged to purchase the cheapest corn in the market that suffered most from the ravages of the disease."

"From 1891 to 1901 Yucatan produced sufficient corn for home consumption, and new cases of pellagra were no longer to be found, * * *."

"From 1901 to 1907 the corn crops were almost total failures and corn was again imported in greater quantities than ever before * * *."

"Pellagra again became epidemic, but was not then confined to the middle and lower classes, as in the former invasion. The wealthy hemp owners, on account of the exorbitant prices paid for hemp, found it was more profitable to import than to raise corn for home consumption, thus compelling even well-to-do people to consume the imported article," which was believed to have been spoiled in transport from the United States. "Pellagra then spread alike among the rich and poor, until by the close of 1907 about 10 per cent of the inhabitants were victims of the disease * * *."

In Barbadoes, B. W. I., the disease, according to Manning (1907), is "confined to the laboring classes and is most prevalent among those who are badly off or poverty stricken. It is very seldom found among the whites, but cases do occur among those in straightened circumstances." In the pioneer reports on pellagra in the United States such references as are made to the relation of economic status to the disease are of a very general character and appear for the most part to be echoes of European opinion. So far as we are aware credit for the first study of this relationship is due to Siler and Garrison (1913). This study was made in South Carolina in 1912 and relates to pellagrins alone. In recording their data relating to the economic conditions under which the patients lived, Siler and Garrison adopted five classes, namely, squalor, poverty, necessities, comfort, and affluence. Of the 277 cases so classified, the economic conditions were reported as poor (squalor, poverty, necessities) in 83 per cent, within the average (comfort) in 15 per cent, and well above the average (affluence) in 2 per cent.

Jobling and Petersen (1917) in their second year's study of the epidemiology of pellagra in Nashville, Tenn., "endeavored to make a most accurate study of the economic condition of pellagrous patients." "In order to do this," they state that their examiners "ascertained the average rentals for the entire city, the weekly income of the pellagrin when a wage earner, and the total income of the pellagrous family." From these data the amount of money available for each pellagrin per week was computed by dividing the total income by the number of individuals, children being accorded the same value as adults.

They found that 70 per cent of their white adult male pellagrins were wage earners, more than 60 per cent of whom earned $10 or more per week. Of the white adult females, 22 per cent were wage earners, and of these, 56 per cent earned less than $10 per week. Of the colored wage earners, 66 per cent of the males earned less than $10 per week, while a similar per cent of the females earned under $8 per week.

When the amount of money available for each pellagrin per week was estimated, Jobling and Petersen found that of the whites 56.5 per cent and of the colored 24 per cent had an available income of $2.50 or more per week.

These workers also made an estimate of the economic status of the pellagrous class on the basis of rentals, which they considered a "fairly reliable basis" for this purpose. They found that of the whites 11 per cent and of the colored 16 per cent owned their own homes or were buying them on the installment plan. "The rentals paid by the balance were practically all under $15 per month, only 3 per cent of the cases occurring in families paying more than this amount. Of the colored families few pay more than $8 per month."

It will be observed that the study of Jobling and Petersen, like that of Siler and Garrison, concerns itself exclusively with the pellagrin. Neither study affords any basis for a comparison with the economic distribution of the general population so that neither these nor, so far as we are aware, any previous observations give us any means of measuring in a definite objective manner the degree of association between economic status and pellagra incidence. This deficiency we have endeavored to repair by the study that we shall now proceed to detail.

II. PLAN AND METHODS OF PRESENT STUDY.

LOCALITY.

The study was made in seven representative cotton-mill villages situated in the northwestern part of South Carolina.

POPULATION.

The villages were of about average size; none had over 800 or less than 500 inhabitants. Each constituted a distinct, more or less isolated community in close proximity to a cotton-cloth manufacturing plant and was composed practically exclusively of the mill employees and their families. The few Negro families present and living somewhat apart were not considered, so that our study deals with an exclusively white population, which, with hardly a single exception, was of Anglo-Saxon stock born in this country of American-born parents. Besides the Negroes, there were also excluded from this study the mill executives, store managers, clerks, and their households, so that we had left for study an exceptionally homogeneous group with respect to racial stock, occupation, and general standard of living, including dietary custom. An enumeration of the population was made in May and June in connection with the collection of our dietary and economic data, and totaled about 4,160 people, included in about 750 households.

PELLAGRA INCIDENCE.

The procedure adopted for determining the incidence of pellagra in this population has been described at length in a previous paper of this series.[7]

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[7] Goldberger, Wheeler, and Sydenstricker, 1920 *a*.

Briefly, in order to ascertain the incidence of the disease as completely as possible, the expedient of a systematic biweekly house-to-house search for cases was employed and practically exclusively depended on.

Only cases with a clearly defined, bilaterally symmetrical dermatitis were recorded as pellagra; cases with poorly defined eruptions, or those with more or less suggestive manifestations but without clearly marked eruption, were recorded at most as "suspects" and are excluded from present consideration.

Just as in our study of pellagra incidence in relation to diet, so here, in relating pellagra incidence to economic conditions, no distinction is made between first and recurrent attacks, but all active cases as above defined are considered. So-called inactive or quiescent cases, that is, individuals who had had the disease in a previous year but during 1916 presented no definite eruption or evidence sufficient to be classed as "suspects," are considered as nonpellagrous.

As a considerable proportion of the population of any village is of transient character,[8] and as much of the pellagra occurs in this class,[9] some assumption was necessary on the basis of which cases might be assigned to households and villages. Accordingly the rule was adopted that a case was to be charged to a household or village only if the affected individual had been a member of that household or had resided in the village not less than 30 days immediately preceding the beginning of the attack (as above defined).

SEASON.

It would seem reasonable to expect, if diet, economic status, or other factor has any influence in relation to the seasonal rise in incidence of the disease, that this influence is most effective during a

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[8] See in this connection Goldberger, Wheeler, and Sydenstricker, 1920 *b*.

[9] This is clearly suggested by the following table, length of residence being assumed to be a fair index of the moving habit of the household.

Pellagra incidence in families, according to length of residence, in seven cotton-mill villages of South Carolina during 1916.

Length of residence in village.	Families classified according to length of residence in village.		Pellagra incidence in families residing specified periods in village.	
	Number considered.	Per cent residing specified periods.	Number of pellagrous families.	Per cent of families pellagrous.
Any period	753	100.0	56	7.4
Less than 1 year	297	39.5	32	10.8
1 year	74	9.8	5	6.8
2-4 years	189	25.1	9	4.8
4 years or more	193	25.6	10	5.2

period immediately anterior to the sharp rise and peak of incidence. Such statistics of pellagra morbidity as were available to us at the beginning of our study indicated that the rise of the seasonal curve of pellagra incidence in the southern States began in the late spring and reached its peak in June. It was assumed, therefore, that the factors favoring the production of pellagra were most effective during the season beginning some time in the late winter or early spring and continuing up to or possibly somewhat into June. The period actually selected by us as representative of this season extended from April 16 to June 15, 1916. Information relating to family income, household food supply, and the composition of the households, etc., for sample sections of this period was secured by trained enumerators who canvassed the village in successive 15-day periods under the immediate direction and supervision of one of us (E. S.)

DIETARY DATA.

The methods adopted for securing data relating to diet have been described fully in a previous communication (Goldberger, Wheeler, and Sydenstricker, 1920 *a*). It will suffice in the present connnection to recall that these data relate to the food supply of the household, not to that of the individual, and so do not indicate the differences that may have existed in the diets of the individual members. It being impracticable to secure our dietary data simultaneously in all villages, the record of household food supply secured in the several villages was for successive 15-day periods between April 16 and June 15. It was assumed that an accurate record for a 15-day period would be a sufficiently representative sample of the supply of the season immediately anterior to the peak of seasonal incidence of the diease, that is, of what may be considered as the pellagra-producing season.

DATA RELATING TO ECONOMIC CONDITIONS.

Since nearly 90 per cent of the individuals composing the population studied were found to be dependent upon the income of family groups composed of more than one person, family income was adopted as the basis for classifying the population according to economic status.

Family income.—The data relating to family income were secured by inquiries of the housewife or of some other responsible member or members of each family, supplemented by data from the mill pay rolls. For the latter we are greatly indebted to the willing cooperation of the administrative officials of the mills.

The information obtained from the families covered (*a*) the rate of daily earnings of each member earning wages during the half month preceding the week of the canvass and the various rates of daily earnings of all members who had been employed during the 12 preceding months; (*b*) the days not at work for all members who had worked for wages during the 12 preceding months; (*c*) the income from all other sources during the preceding half month as well as during the preceding 12 months, this information being secured in detail for each source of income. On the basis of this information it was possible to approximate the total income of each family for the half month preceding the visit of the enumerator, and, roughly, for any part or all of the preceding year.

Finding that approximately 90 per cent of the total income of the families studied came from the earnings of wage-earning members, the family statements of earnings during this half-month period were compared with the records on the mill pay rolls, and, in the great majority of instances, were found to agree closely with them; but in order to reduce the error arising from even slightly inaccurate statements as to wages, the pay-roll records instead of the family statements have been used to supply the earnings data. For that small proportion of family income made up of wages earned in employment outside of the mills and of the amounts derived from other miscellaneous sources, the family statement was necessarily accepted.

On the basis of the results of some preliminary tabulations it was decided that the family income during the half month preceding the week of the enumerator's canvass would be a fairly accurate indication of family income during the season selected as most significant in relation to the occurrence of pellagra. The basis for classifying families with respect to income was, therefore, the total cash income of each during a 15-day period between April 16 and June 15, 1916. A half-month sample period was used, partly because it corresponded to the sample period for which dietary data were secured and partly because a majority of the mills in the villages paid at semimonthly intervals. The pay-roll data from other mills were adjusted to a half-month basis.

In the course of the canvass of the homes of the mill workers' families other data affecting the economic status of the families were also collected. These related principally to length of experience in mill work, occupational status of wage earners, and the amount and incidence of disabling sickness[10] among wage-earning and other members of households.

Availability of food supply.—With the view of studying the relation of food availability to pellagra incidence, information was collected under the immediate direction of one of us (E. S.), relating to conditions that might effect the supply of a given food or foods. In collecting and recording this information a uniform method was followed as closely as possible except where specific points suggested the advisability of special inquiry. The principal sources of information and the nature of the information sought were as follows:

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[10] See Sydenstricker, Wheeler, and Goldberger, 1918.

(1) Statements were obtained from households as to the immediate source of every article of food entering into their half-month's supplies. Thus it was ascertained, for example, whether the fresh milk used by the household was produced at home, purchased from another mill worker's household in the village, or from some specific farmer, dairy, or store, or donated by a relative, neighbor, or other person. In the event that a household had a source of supply not common generally to households in the village, inquiries were directed with a view of ascertaining the length of time the household had had such a supply, particularly, with respect to the period after January 1, 1916.

(2) From farmers, hucksters, or "peddlers" selling from house to house, statements were secured relating to the quantities sold, prices, frequency of selling, and character of produce sold since January 1, 1916.

(3) From managers and clerks in the stores, markets, and other retail establishments at which mill workers' households largely dealt, data were secured relating to (*a*) prices during the 15-day period and price changes during 1916; (*b*) sources of each food sold, whether direct from near-by farms or through middlemen from local agricultural territory or from other sections of the United States; (*c*) names of brands and quantities of the foods sold; (*d*) practices with respect to credit to mill workers' households, especially as affected by the amount of earnings by the mill workers.

ECONOMIC CLASSIFICATION.

Method of classification according to economic status.—As has already been mentioned, the great majority of the individuals composing the population studied were members of families who subsisted on the income of families composed of several persons; the small proportion not subsisting on such family income were boarders living under substantially the same conditions as the families with which they boarded. It would seem permissible, therefore, to classify these economically with the members of the family with which they boarded, although it is fully recognized that in so doing a certain, though, for the present purpose, unimportant, error is involved.

In classifying this population according to economic status on the basis of family income the conventional method of using total family income for a given period was found to be so inaccurate in many instances as to be misleading. The average total annual cash income of all of the families for which income data were secured was about $700, and relatively few had annual incomes of over $1,000. Thus the range of total income was relatively small and the families were, from this point of view, fairly homogeneous. They differed, however, very markedly in size and with respect to the age and sex of their members. Manifestly it was improper to classify, for example, a family whose half-month's income was $40, and was composed of only a man and his wife, with one whose half-month's income was also $40, but was composed of a man, his wife, and several dependent children. Since family income, for the purpose of this study, was used as an index of the economic status of individuals who composed the family group, it was necessary to take into consideration the number of such individuals in comparing one family with another. A per capita statement of income, however, while more accurate than the statement of total income, was subject to the inaccuracy arising from differences in the age and sex of members of the families to be compared. It appeared advisable, therefore, to employ a common denominator to which the individuals of both sexes and of all ages could be reduced in order to obtain a more accurately representative method of expressing the relative size of the families to be compared.

In the absence of a better common denominator for this purpose, the Atwater (1915) scale of food requirements was employed, and the size of each family was computed according to this scale and expressed in terms of "adult male units."[11] The assumption in the use of this scale was that the expenditures for total maintenance for individuals varied according to sex and age in the same proportion as did their food requirements. The assumption is by no means as accurate as could be desired; in its favor, however, it may be said that since family expenditures in the great majority of cases equaled total family income, and since food expenditures were nearly half (among poorer families considerably more than half) of total expenditures, a scale based on food requirements alone is obviously very much more accurate than one omitting any consideration whatsoever of the number, sex, and age of the individuals composing the families

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[11] The scale used was as follows:

Age.	Equivalent adult male unit.	
	Male.	Female.
Adult (over 16)	1.0	0.8
15 to 16	.9	.8
13 to 14	.8	.7
12	.7	.6
10 to 11	.6	.6
6 to 9	.5	.5
2 to 5	.4	.4
Under 2	.3	.3

to be compared with respect to income.[12] For the present purpose, therefore, the total income of each family as defined above, has been divided by the number of "adult male units" subsisting on the family income, and the resulting figure has been termed the "family income per adult male unit."

Results of classification.—The 747 families for which income data were sufficiently accurate and complete for consideration have been classified by this method and grouped into four convenient classes, each containing a fair proportion of the total number. Table I presents this classification and also the resulting distribution of individuals and their equivalent "adult male units."

The differences in income are also indicated in Table II, which permits of a comparison of the results of classification on the basis of the average income during the half-month period per family, per person, and per "adult male unit." Table III, based on Table II, permits of the same comparison and perhaps expresses these differences more clearly. It will be noted that the same *general* differences

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[12] In order to establish a more accurate basis for computing the size of families in comparing their incomes, a detailed study of expenditures for individuals in a number of representative families in cotton-mill villages was undertaken during 1917. While the tabulations of these data were not completed in time for use in the study of the data collected in 1916, it appears that the Atwater scale is roughly indicative of the variations, according to sex and age, in the consumption of all articles for which there are individual expenditures. It should be noted that before using the Atwater scale in the preliminary computations of family income, several published estimates of the cost of maintenance for individuals of various ages were examined. These estimates were based, in several instances, upon the results of investigation of actual expenditures of individual members of families. Using the estimated expenditures for an adult male as 100, the estimates for individuals of other ages of either sex were expressed relatively and compared with the Atwater scale. It appeared that, in most instances, the scales were fairly similar. The following table, computed from probably the most pertinent data available, indicates the relative cost of maintenance (at a "fair standard of living") for a year of individuals of various ages as estimated for Southern cotton-mill workers by the United States Bureau of Labor in 1911, in comparison with the Atwater scale for food requirements.

Comparison of the relative variations in individual expenses for all purposes with variations in individual food-requirements according to age and sex.

Age.	Male.		Female.	
	Individual expenses (U. S. Bureau of Labor).	Food requirements (Atwater).	Individual expenses (U. S. Bureau of Labor).	Food requirements (Atwater).
Adult (over 16)	100	100	89	80
15 to 16	85	90	79	80
13 to 14	72	80	67	70
12	61	70	57	60
10 to 11	56	60	59	60
6 to 9	45	50	46	50
2 to 5	34	40	35	40
Under 2	26	30	26	30

The individual expenses estimated were for food (estimated by the U. S. Bureau of Labor, according to the Atwater scale), clothing, medical attendance, and medicines, insurance, amusements, tobacco, and school books. See report on Conditions of Women and Child Wage Earners in the United States, Vol. XVI, Family Budgets of Typical Cotton-Mill Workers by Wood F. Worcester and Daisy Worthington Worcester, Sen. Doc. 645, 61 Cong., 2d sess., 1911, p. 150.

in *average* incomes for the four groups are indicated by any of the three methods of classification. For reasons already stated, however, the "adult male unit" method is believed to be more accurately representative of actual conditions than either of the others and, therefore, to be preferred for the classification of individual families; it is the method hereinafter employed.

TABLE I.—*Number of families and members of families and their equivalents in adult male units in seven cotton-mill villages of South Carolina, classified according to family income during a 15-day period between Apr. 15 and June 16, 1916.*

Half-month family income per adult male unit.	Families.	Persons.[a]	Equivalent adult male units.[b]
	Number.	*Number.*	*Number.*
Less than $6.00	217	1,289	866.2
$6.00–$7.99	183	972	675.9
$8.00–$9.99	139	704	529.2
$10.00 and over	208	800	607.1
All incomes	747	3,765	2,678.2
	Per cent.	*Per cent.*	*Per cent.*
All incomes	100.0	100.0	100.0
Less than $6.00	29.1	34.2	32.4
$6.00–$7.99	24.5	25.8	25.2
$8.00–$9.99	18.6	18.7	19.8
$10.00 and over	27.9	21.3	22.6

[a] Exclusive of persons paying board and including only those dependent upon family income.
[b] According to the Atwater scale for food requirements.

TABLE II.—*Average half-month family income, computed in terms of "per family," "per person," and "per adult male unit,"* [a] *for various income classes of the population in seven cotton-mill villages in South Carolina.*

Half-month family income per adult male unit.	All family income during a half month.	Average income during a half month.		
		Per family.	Per person.[b]	Per adult male unit.[b]
Less than $6.00	$3,990.45	$18.38	$3.09	$4.61
$6.00–$7.99	4,780.85	26.12	4.92	7.07
$8.00–9.99	4,642.29	33.40	6.55	8.77
$10.00 and over	7,777.99	37.39	9.72	12.81
All incomes	21,191.58	28.36	5.63	7.92

[a] According to the Atwater scale for food requirements.
[b] Exclusive of persons paying board and including only those dependent upon family income.

TABLE III.—*Ratio of the average income for each income class to that of all income classes of the population of seven cotton-mill villages of South Carolina.*

[The average income is computed in terms of "per family," "per person," and "per adult male unit."]

Family income per adult male unit.	Relative average income during a half month per—		
	Family.	Person.	Adult male unit.
All incomes	100	100	100
Under $6.00	65	55	58
$6.00–$7.99	92	87	89
$8.00–$9.99	118	116	112
$10.00 and over	132	173	162

Before entering upon a consideration of the relation of family income to pellagra incidence it will be desirable to make brief reference to the factors affecting family income. An analysis of our data with a view of determining, so far as practicable, what these were, showed the principal ones to be as follows: (*a*) Supplemental income, chiefly from boarders; (*b*) the number of dependent persons, principally children, in proportion to the number of wage-earning persons in the family; and (*c*) the earning capacity of the wage earners, including chiefly the factors of natural ability, length of training, and state of health. In the classification of this population according to "family income per adult male unit," those persons in the higher income classes appeared distinctly to have the advantage in each of these respects over those in the lower income classes.

III. PELLAGRA INCIDENCE ACCORDING TO ECONOMIC STATUS.

Having considered the methods employed for securing the basic data relating to the occurrence of the disease and for securing those relating to the classification of the population with respect to economic status, we may now proceed to determine the relationship existing between the economic status of the family and the degree of incidence of the disease.

We have in all 747 households for which our data are sufficiently complete and accurate to permit of classification according to income. There were recorded among the members of these households 97 definite cases of pellagra. In Table IV we have distributed these households in accordance with the family income per adult male unit during the sample half-month period and have indicated therein also the number and per cent of the households in each of the resulting five income classes that were affected with pellagra to the extent of (*a*) one or more cases, (*b*) two or more cases, and (*c*), three or more cases.

It will be observed that the proportion of families affected with pellagra declines with a marked degree of regularity as income increases. This inverse correlation is even more clearly shown when weight is given to households with more than one case of the disease,[13] as is done in Table V, in which the incidence of pellagra is expressed as a rate per 1,000 persons in each income class.

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[13] Upon the basis of the average half-month income per adult male unit for each of the income classes and the corresponding pellagra rate per 1,000 persons, the Pearsonian coefficient of correlation is -0.91 ± 0.05. While the small number of classes considered must, of course, be taken into account, the expression indicates high degree of correlation (-1.0 being perfect inverse correlation).

TABLE IV.—*Number and per cent of households of different income classes affected with pellagra in seven cotton-mill villages of South Carolina in 1916.*

Half-month family income per adult male unit.	All households.	Pellagrous households in which were— One or more cases of pellagra.	Two or more cases of pellagra.	Three or more cases of pellagra.
NUMBER.				
Less than $6.00	217	28	17	7
$6.00-7.99	183	21	3	1
$8.00-$9.99	139	8	4	0
$10.00-$13.99	144	3	0	0
$14.00 and over	64	1	0	0
All incomes	747	61	24	8
PER CENT.				
Less than $6.00	100.0	12.9	7.8	3.2
$6.00-$7.99	100.0	11.5	1.6	.5
$8.00-$9.99	100.0	5.8	2.9	0.0
$10.00-$13.99	100.0	2.1	0.0	0.0
$14.00 and over	100.0	1.5	0.0	0.0
All incomes	100.0	8.2	3.2	1.1

TABLE V.—*Number of definite cases of pellagra and rate per 1,000* [1] *among persons of different income classes in seven cotton-mill villages of South Carolina in 1916.*

Half-month family income per adult male unit.	Total. Number of persons.	Total. Number of cases.	Total. Rate[1] per 1,000.	Males. Number of persons.	Males. Number of cases.	Males. Rate per 1,000.	Females. Number of persons.	Females. Number of cases.	Females. Rate per 1,000.
Less than $6.00	1,312	56	42.7	650	20	30.8	662	36	54.4
$6.00-$7.99	1,037	27	26.0	521	6	11.5	516	21	40.7
$8.00-$9.99	784	10	12.8	376	4	10.7	408	6	14.7
$10.00-$13.99	736	3	4.1	363	0	0.0	373	3	8.0
$14.00 and over	291	1	3.4	161	1	6.2	130	0	0.0
All incomes	4,160	97	23.3	2,071	31	14.9	2,089	66	31.6

[1] Since a marked variation in the pellagra rate according to age and sex was found for the population studied (Goldberger, Wheeler, and Sydenstricker, 1920 *b*), and since, ordinarily, differences in the distribution of persons according to age occur in different economic groups, computation of rates adjusted to a standard population was made. The influence of differences in the sex distribution in any age group was insignificant, and practically the same incidence rates were obtained after making adjustments to a standard age distribution, as is shown in the following table:

TABLE V*a*.—*Comparison of crude pellagra rates and of rates after adjustment for age to a standard population for each income class.*

[Standard population=total population, all incomes.]

Family income per adult male unit.	Case rate per 1,000. Crude.	Case rate per 1,000. Adjusted.
Less than $6.00	42.7	41.0
$6.00-$7.99	26.0	24.8
$8.00-$9.99	12.8	14.2
$10.00-$13.99	4.1	5.2
$14.00 and over	3.4	2.5

The occurrence of multiple-case families, especially from the point of view of difference in income, invites special comment. The 97 cases of pellagra occurred in 61 families. In each of 24 of these families, two or more cases occurred, while in each of 8, three or more cases developed. Taking into consideration the size of the families and assuming that all individuals were equally susceptible to the disease,[14] a computation of the probability of the occurrence of multiple-case families according to purely chance distribution indicated that in the 747 families we should expect about 90 families with one case each, about 8 families with two or more cases, while the probability of households each with three or more cases would be less than 2 in 10,000. The actual occurrence of 24 families with two cases each and of 8 families with three or more cases would thus seem to be far in excess of the result of chance.[15] The fact that multiple-case families occurred only in the lower-income classes and that families with three or more cases occurred practically only in the lowest-income class plainly shows that the tendency toward concentration of cases in certain families increases as income diminishes. Pellagra incidence in the population studied therefore not only varied inversely according to family income, but with decreasing income it seemed to show an increasing tendency to affect members of the same family.

DISCUSSION.

The very marked inverse correlation between low income and pellagra incidence naturally calls for explanation. Under the conditions of the study the following possibilities in this regard suggested themselves for consideration:

(*a*) Bad hygiene and sanitation;

(*b*) Difference in sex and age composition of the population in the several income classes; and

(*c*) Difference in diet.

(*a*) *Bad hygiene and sanitation* are in general closely associated with poverty so that the incidence of a disease, the dissemination of which is favored by such conditions, may be expected to be unusually high in the lower economic strata. Consequently it is natural to suspect that a disease found to be highly prevalent in an environment of poverty is dependent on the almost inevitably attendant unhygenic and insanitary conditions for its propagation, and to assume that it is of microbial origin. The possibility of an essential infective etiological factor in this disease has therefore been given careful consideration, and in a previous paper (Goldberger, Wheeler, and Sydenstricker, 1920 *c*) we reported the results of our study of the relation of certain factors of a sanitary character to the incidence of pellagra in these villages. No consistent correlation was found.[16] This, coupled with the results of the other of our own studies (see discussion by Goldberger and Wheeler, 1920, pp. 36–41) and of the studies of other investigators (White, 1919; and Boyd and Lelean, 1919), and with the fact of the complete absence of any unequivocal evidence in support of an essential infective etiological factor in this disease, not only renders discussion of hygienic and sanitary factors in the present connection unnecessary but, we believe, permits of their dismissal from further serious consideration.

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[14] So far as sex and age are concerned, all families (with but few exceptions) contained fairly comparable proportions of "susceptible" individuals.

[15] Acknowledgment is made to Associate Statistician F. M. Phillips, United States Public Health Service, for assistance in this computation.

(*b*) *Differences in sex and age composition of the population in the several income classes.*—We have shown in a previous communication (Goldberger, Wheeler, and Sydenstricker, 1920 *b*) that the incidence of the disease in the population of these villages differs markedly in the sexes and at certain age periods; it is conceivable, therefore, that differences in the sex and the age distribution in the different income classes might give rise to the phenomenon under discussion. That this is not the case, however, is evident (1) when it is recalled that we are dealing with a population composed of family units and (2) when we compare the indications afforded by Tables V and VI, showing, respectively, the sex and the age distribution of the population of each economic class, and note the agreement in the indications afforded by the crude rates and by the rates after adjustment to a standard population (footnote to Table V).

TABLE VI.—*Number and per cent of persons in each income class, classified according to age, in 7 cotton-mill villages of South Carolina in 1916.*

[The classes being divided from each other at those ages at which the pellagra incidence rate for the whole population varies most sharply.[a]]

Half-month family income per adult male unit.	Age group.							
	All ages.	Under 5 years.	5-9	10-19	20-29	30-44	45-54	55 years and over.
				NUMBER.				
Less than $6.00	1,312	260	251	317	162	217	49	56
$6.00-$7.99	1,037	162	166	270	172	166	60	41
$8.00-$9.99	784	104	108	229	149	114	48	32
$10.00-$13.99	736	95	69	173	215	102	46	36
$14.00 and over	291	27	15	71	91	63	9	15
All incomes	4,160	648	609	1,060	789	662	212	180
				PER CENT.				
Less than $6.00	100	19.8	19.1	24.2	12.4	16.5	3.7	4.3
$6.00-$7.99	100	15.7	16.0	26.0	16.6	16.0	5.8	3.9
$8.00-9.99	100	13.3	13.8	29.2	19.0	14.5	6.1	4.1
$10.00-$13.99	100	12.9	9.4	23.5	29.2	13.9	6.2	4.9
$14.00 and over	100	9.3	5.2	24.4	31.3	21.6	3.1	5.2
All incomes	100	15.6	14.6	25.5	19.0	15.9	5.1	4.3

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[16] The data collected during 1916 were not in a form to permit the study of the relation of crowding in the home to pellagra incidence. We may state, however, that a preliminary analysis of a considerable mass of data bearing on this point, collected during 1917, shows very little, if any, correlation between them when the effect of income is minimized.

[a] See Goldberger, Wheeler, and Sydenstricker, 1920 *b*.

(*c*) *Differences in diet.*—The results of budgetary investigations have repeatedly demonstrated the association of marked variations in diet with variation in family income.[17] It seemed doubly pertinent, therefore, to inquire what, if any, variations in diet were associated with variations in income among the families of our cotton-mill villages. Accordingly, we prepared Table VII, showing the average food supply of the households of the several income classes. To facilitate comparison between the averages thus presented, indices have been computed, the figures for the households with the highest income being used as the base. It will be noted that, from the point of view of income, the following general tendencies are suggested:

1. The smaller the income the smaller were the supplies purchased of all meats (except salt pork), green vegetables, fresh fruits, eggs, butter, cheese, preserved milk, lard, sugar (including sirup), and canned foods.
2. The smaller the income the larger were the supplies purchased of salt pork and corn meal.
3. In the households of the various income classes the quantities of the purchased supplies[18] of dried peas and beans, potatoes, dried fruits, wheat flour and bread, fresh milk, and rice appeared without any consistent trend.

Thus it appears that there were associated with differences in family income quite definite differences in household food supplies. In order to determine the outstanding differences more clearly, the households with intermediate incomes were disregarded and comparison was made of the food supplies in households presenting the greatest contrast from an economic standpoint (i. e., those households representing the respective extremes of family income), with the result that not only did the differences already noted stand out more clearly, but, in addition, it appeared that the supplies of wheat flour and bread and of fresh milk were appreciably smaller in the poorest households.

In that part of our study dealing with the relation of household food supply to pellagra incidence (Goldberger, Wheeler, and Sydenstricker, 1920*a*) a very definite significant relationship between the character of the diet and the incidence of the disease was demonstrated, and since, as we have seen above, a marked inverse correlation exists between the amount of family income and the degree of incidence of the disease, it follows that the character of the diet of the population under consideration may be expected to vary with the amount of family income, in the sense at least that the lower the income the more the character of the diet will tend to approach that associated with pellagra. This is confirmed by the quite definite differences in food supply above actually shown to be associated with differences in family income, and further by the fact that when comparison is made, such as Table VII and Fig. 1 permit, it is found that in a general, but quite definite, way the food supply of the households of the lowest-income class tends to be similar to that of the group of pellagrous households in each of which at least two cases of pellagra occurred prior to August 1, 1916; that is, similar to that of the group whose food supply more closely approximates a representative sample of a pellagra-producing diet than does any other afforded by our study.

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[17] In this connection see Sydenstricker, 1915.

[18] Practically all food supplies, with the exception of fresh milk, were purchased (i. e., not home-produced) during the season (the late spring) of the year under consideration. Households securing supplies of milk from home-owned cows have not been included in the above table (Table VII), since supplies of food from this source constitute a factor affecting the diet of the population apart from the factor of family income. They are considered in another connection.

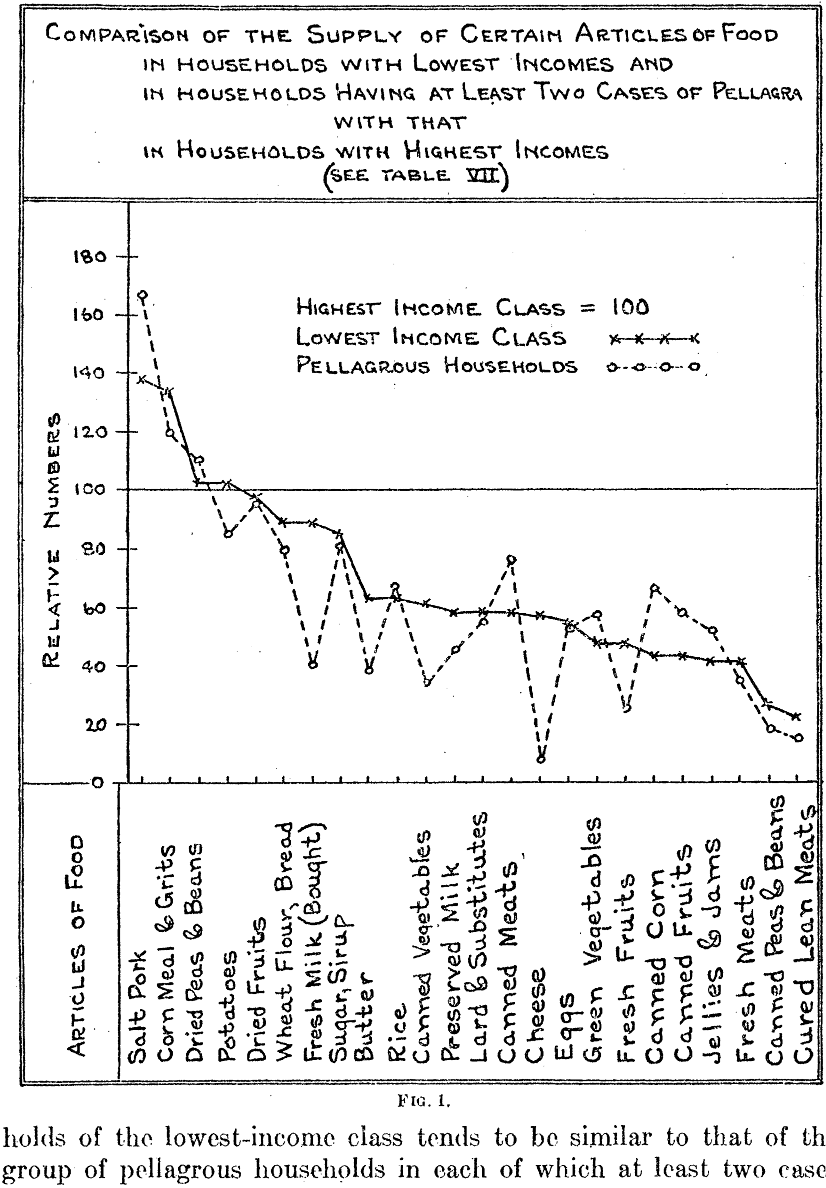

Fig. 1.

TABLE VII.—*Average supply (per adult male unit) during a 15-day period between Apr. 15 and June 16, 1916, of various purchased articles of food*[a] *in households of different income classes and in the group of those households in each of which two or more cases of pellagra occurred prior to Aug. 1, 1916.*

GRAMS PER ADULT MALE UNIT PER DAY.

Half-month family income per adult male unit.	Salt pork.	Corn meal and grits.	Dried peas and beans.	Potatoes.	Dried fruits.	Wheat flour, bread.	Fresh milk (bought).	Sugar sirup.	Butter.	Rice.	Canned vegetables.	Preserved milk.	Lard and lard substitutes.	Canned meats.	Cheese.	Eggs.	Green vegetables.[b]	Fresh fruits.	Canned corn.	Canned fruits.	Jellies and jams.	Fresh meats.	Canned peas and beans.	Cured lean meats.
$14.00 and more	39	126	31	71	10	447	319	59	30	8	58	4	63	20	3	59	105	41	9	27	11	47	9	53
$10.00–$13.99	49	152	31	107	9	434	302	61	35	6	36	4	54	12	2	57	63	33	10	26	10	32	6	28
$8.00–$9.99	54	151	35	97	9	410	342	67	14	5	37	3	49	16	3	44	60	31	8	24	8	30	4	24
$6.00–$7.99	56	174	33	88	9	460	317	55	19	4	46	1	49	14	2	38	61	30	6	14	9	21	5	20
Less than $6.00	54	169	31	73	10	399	282	50	19	5	35	2	37	12	2	33	49	19	4	12	5	19	2	12
Pellagrous households.	65	150	34	60	10	361	127	48	11	6	20	2	35	16	(*c*)	31	61	10	6	16	6	16	2	8

RELATIVE NUMBERS. BASE: SUPPLY PER ADULT MALE UNIT PER DAY IN HOUSEHOLDS WITH HIGHEST INCOMES.

Half-month family income per adult male unit.	Salt pork.	Corn meal and grits.	Dried peas and beans.	Potatoes.	Dried fruits.	Wheat flour, bread.	Fresh milk (bought).	Sugar sirup.	Butter.	Rice.	Canned vegetables.	Preserved milk.	Lard and lard substitutes.	Canned meats.	Cheese.	Eggs.	Green vegetables.[b]	Fresh fruits.	Canned corn.	Canned fruits.	Jellies and jams.	Fresh meats.	Canned peas and beans.	Cured lean meats.
$14.00–and more	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
$10.00–$13.99	126	121	100	151	90	97	95	103	117	75	62	100	86	60	67	97	60	81	111	96	91	68	67	53
$8.00–$9.99	138	120	113	137	90	92	107	114	47	63	64	75	78	80	100	75	57	76	89	89	73	64	44	45
$6.00–$7.99	144	138	107	124	90	103	99	93	63	50	79	25	78	70	67	64	58	73	67	52	82	45	56	38
Less than $6.00	138	134	100	103	100	89	88	85	63	63	60	50	59	60	67	56	47	46	44	44	45	40	22	23
Pellagrous households.	167	119	110	85	100	81	40	81	37	75	34	50	55	80	......	53	58	24	67	59	55	34	22	15

[a] For explanation of terms, see Goldberger, Wheeler, and Sydenstricker 1920*a*, appendix.

[b] Includes string beans.

[c] Less than 0.5 of a gram.

DIFFERENCES IN INCIDENCE AMONG HOUSEHOLDS.

From the foregoing considerations the conclusion would seem to be suggested that the inverse correlation between pellagra incidence and family income depended in large measure, if not entirely, on the unfavorable effect of a low income on the character of the diet. In this connection, however, it must be noted and consideration must be given to the fact that a large proportion of households with low incomes were not affected with the disease.[19] Thus, in the village of *In*, where the highest of the incidence rates observed by us in 1916 occurred and where the rate among persons constituting the households with incomes under the average was 90 per 1,000, over 65 per cent of these poorer households appeared not to be affected, and, in varying degree, this was true of each of the seven villages studied. That the exemption of these families from pellagra was not due to a lack of subjects of "susceptible" sex is evident from what has already been said on this point; and that it could not be attributed to lack of human material of "susceptible" age appears very clearly when the distribution of the population according to age is compared for the pellagrous and for the poorer nonpellagrous households in a representative village, as is done in Table VIII. Manifestly, therefore, the amount of family income—that is, money income (in the sense here used), such as wages, cash payments from boarders, cash receipts from sales of supplies, and other sources—was not the sole factor determining the character of the household diet.

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[19] Similarly, a large proportion of the members of pellagrous households were apparently unaffected by the disease. As has already been stated, the present study deals with the household, not with the individual, excepting only as to pellagra incidence. We have, therefore, no special data on which an explanation of the exemption of the unaffected members of a household might be based. Nevertheless, in the light of (*a*) certain general observations and (*b*) of analogies to such food deficiency diseases as scurvy and beriberi, together with (*c*) the knowledge gained as the result of the newer work of many students in the field of diet and nutrition, the following suggestions may properly be submitted for consideration in this connection:

1. *Differences in diet consumed among individuals of the household.*—Although all members of a household presumably have the same diet available, as the result of individual likes and dislikes, observable at almost any table, slight differences in diet actually consumed are common and marked differences, amounting in some instances to outstanding individual eccentricities, are not rare. Furthermore, differences in diet actually consumed may arise from, or be accentuated by, food eaten between meals and by supplemental foods of one kind or another in respect to which individuals of the same household may differ considerably. Clearly, then, a knowledge of the exact composition of the diet of a household or other dietary group does not necessarily justify the assumption of a knowledge of the composition of the diet consumed by an individual member of such household or group. Failure to appreciate this, it may be noted, has been a frequent cause of serious error and consequent confusion in connection with studies of food-deficiency diseases.

2. *Differences in individual susceptibility or resistance.*—Assuming identity of diet actually consumed, differences in incidence among individuals of the same household or other dietary group may result from individual variation in resistance or susceptibility, which may conceivably be related to (*a*) an inherent individual characteristic, (*b*) the age or sex of the individual, (*c*) the existence of some exhausting underlying disease or condition (hookworm, dysentery, duodenal fistula), or (*d*) to unlike physical strain or exertion.

3. *Combinations of factors 1 and 2.*

TABLE VIII.—*Age distribution of population constituting the nonpellagrous households with low family income*[a] *and the pellagrous households of the mill village of In.*

Households.	Age groups.							
	All ages.	Under 5.	5-9	10-14	20-29	30-44	45-54	55 and over.
NUMBER OF PERSONS.								
Nonpellagrous	265	52	53	61	33	45	14	7
Pellagrous	168	31	32	49	19	31	5	1
All households	433	83	85	110	52	76	19	8
PER CENT.								
Nonpellagrous	100.0	19.6	20.0	23.0	12.5	17.0	5.3	2.6
Pellagrous	100.0	18.5	19.0	29.2	11.3	18.5	3.0	.6
All households	100.0	19.2	19.6	25.4	12.0	17.5	4.4	1.8

[a] That is, under $8 per adult male unit during a half-month period in the late spring of 1916.

This is quite in accord with common experience, which teaches that there are many factors that, singly or in varying combination, may have an important influence on the character of the diet and that may vary among and thus may distinguish different households of the same income. In illustration of this, reference may be made to the group of factors that tend to determine the amount and proportion of family income available for the purchase of food, an example of which is the occurrence of sickness or injury, making an unusual draft on the family income. Related to such factors are the general spirit of the household with respect to thrift (which, when unwisely directed, may be harmful) and the intelligence and ability of the housewife in utilizing the available family income.

More tangible than these, and perhaps of more immediate practical importance in its effect on the household diet, is the difference among households with respect to the availability of food supplies. We found that, among households with similar incomes and of the same village and thus with access to the same markets, there were some more favorably situated in having sources of food supplies that others either did not possess or possessed in a lesser degree. Such sources frequently were gardens, home-owned cows, swine, poultry, and the like.

DIFFERENCES IN INCIDENCE AMONG VILLAGES.

Besides differences among households with similar incomes and of the same village, quite marked differences in pellagra incidence were also observed, as has already been pointed out, among the villages themselves. We have sought to determine the explanation of this by considering in order the various possibilities that suggested themselves.

(*a*) The general environment (except as to condition of sanitation and food supply), the origin and type of the population, the character of work, and the general habits of living among these populations being, as we have already stated, strikingly similar, do not call for consideration in the present connection.

(*b*) Differences in sanitary conditions among villages were noted and their relation to differences in the incidence of the disease was studied without, however, discovering any consistent correlation among them. Reasons have been given why hygienic and sanitary factors might be dismissed from consideration in the attempt to explain the inverse correlation between family income and the incidence of pellagra.[20] Further discussion of these factors in the present connection would therefore seem to be unnecessary.

(*c*) The marked association between low family income and pellagra incidence suggested the possibility that the difference in incidence among villages might be associated with a difference in the proportion of families of low incomes included in the populations of the several villages. But if the differences in the proportion of the population which had low incomes in the various villages be compared with the differences in pellagra incidence, as is done in Table IX, no consistent correlation is disclosed. Clearly the differences in pellagra incidence among these villages can not be accounted for by differences in the economic status of the populations concerned.

TABLE IX.—*Comparison of the relation of rate of pellagra incidence to proportion of population of low family income in seven mill villages of South Carolina in 1916.*

Village.	Per cent of population whose half-month family income per adult male unit was less than—		Pellagra rate per 1,000 population (all incomes) in 1916.
	$6.00	$8.00	
All villages	31.5	56.5	23.4
At.	37.0	64.3	20.7
In.	40.9	66.6	64.6
Ny.	26.2	45.7	0.0
Rc.	13.2	23.7	24.9
Sn.	38.3	58.1	10.9
Sa.	28.3	57.4	25.7
Wy.	31.0	64.0	18.7

Pearsonian coefficient of correlation: $r=0.33\pm0.23$.

(*d*) As family income is simply an index of the power to buy, and as this power is obviously limited by the cost of the thing desired (in this instance food), the thought naturally suggests itself that differences in prices in the different villages might be of importance in the present connection. That this was a negligible factor, however, is shown by the fact that we found no significant differences in food prices in the different villages.

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[20] See pages 2688 and 2689.

(*e*) That individuals of "susceptible" ages may have been present in relatively insignificant numbers in the villages among whose poorer households few if any were affected by the disease, and that this may account for the differences, is an explanation that may be dismissed from consideration when the age distribution of the population is compared according to village, as may be seen by reference to Table X.

TABLE X.—*Comparison of the age distribution of the population constituting the households with low family incomes*[a] *of seven cotton-mill villages of South Carolina.*

Villages.	All ages.	Classified by age periods (years).						
		Under 5 years.	5-9	10-19	20-29	30-44	45-54	55 and over.
NUMBER OF PERSONS.								
At	367	65	65	82	63	59	18	15
In	433	83	85	110	52	76	19	8
Ny	331	60	56	87	45	57	15	11
Rc	206	37	42	50	34	32	5	6
Sn	338	65	46	69	61	52	14	31
Sa	268	51	51	68	40	34	14	10
Wy	407	62	72	120	39	73	24	17
All villages	2,350	423	417	586	334	383	109	98
PER CENT.								
At	100.0	17.5	17.5	22.3	17.2	16.1	4.9	4.1
In	100.0	19.2	19.6	25.4	12.0	17.5	4.4	1.8
Ny	100.0	18.1	16.9	26.3	13.6	17.2	4.5	3.3
Rc	100.0	18.0	20.4	24.3	16.5	15.5	2.4	2.9
Sn	100.0	19.2	13.6	20.4	18.0	15.4	4.1	9.2
Sa	100.0	19.0	19.0	25.4	14.9	12.7	5.2	3.7
Wy	100.0	15.2	17.4	29.5	9.6	17.9	5.9	4.2
All villages	100.0	18.0	17.7	24.9	14.2	16.3	4.6	4.2

[a] That is under $8 per adult male unit during a half month in the late spring of 1916.

(*f*) We thus come to a consideration, finally, of differences among villages with respect to availability of food supplies on the local markets or from home production. More or less marked differences in this respect were found to exist. In relating these to differences in pellagra incidence it should be borne in mind that the availability to a consumer of a supply of a given article or group of articles of food is often involved in a number of interrelated conditions, the influence of any one of which may be difficult to measure. Therefore, in analyzing community conditions affecting the supply of any article or articles of food, only the outstanding and clearcut differences between localities can be considered. Furthermore, since even considerable differences in pellagra incidence among localities of small population are not necessarily a reflection of community conditions, it seemed desirable to select for the study of the relationship under consideration villages presenting the most marked contrast in the incidence of the disease, thereby avoiding the possibly confusing effects of irregularities likely to arise in attempts to relate community conditions of food availability to pellagra rates for which community conditions were possibly responsible only in part or not at all. There was, moreover, the compelling practical consideration to thus restrict ourselves in the fact that the amount of labor involved in a detailed study of conditions in each of our villages was beyond the physical capacity of the available personnel to perform. Accordingly we selected for study *Ny* village, with no pellagra, and *In* village, with a rate of not less than 64.6 per 1,000 during 1916. The facts, as we were able to determine them relating to the availability of supplies of various foods in these two villages, are briefly summarized in the following:

(1) *Retail grocery establishments.*—In both villages the mill workers' households purchased their supplies of all foods from the company stores and from grocery stores in adjacent communities, with the exception of fresh meats, fresh milk, and varying proportions of their supplies of eggs, butter, green vegetables, and fresh fruits. Exclusive of the articles named, the availability of supplies of all foods appeared to be the same in both villages for the reasons that (*a*) in both villages there existed company stores which carried in stock practically the same kinds of foods and were operated along similar lines from the point of view of credit allowances to mill workers, and (*b*) within a mile of either village were general grocery stores carrying in stock the same kinds and varieties of foods as those sold at the company stores. The company stores at *Ny*, however, did not sell fresh vegetables, potatoes, and fresh fruits, there being an agreement with the lessee of the village market to the effect that the latter should have the exclusive store privilege of selling these articles. A much more regular and abundant supply of fresh vegetables and fruits was available at the *Ny* market than at the *In* company store.

It is of interest to note that the *In* households, whose incomes were less than the average income for the two villages, relied to a greater extent upon the company store than the *Ny* households with similar incomes. This is indicated by the purchase and food supply records during the 15-day period from May 16 to May 30, 1916, which show that 60 per cent of the *In* households purchased all of their groceries (exclusive of home produce and produce from near-by farms) from the company store as compared with only 13 per cent of the *Ny* households.

(2) *Fresh-meat markets.*—In *Ny* there was a fresh-meat market which had been open seven days in the week the year round for several years. This market, as already noted, also sold fresh fruit

and vegetables. The nearest other market was 1 mile away, and this market operated a wagon which regularly had taken orders and delivered fresh meat in the village at the doors of the mill workers' households during the spring and the preceding fall and winter. At the town of Seneca, 4 miles away, there were two other fresh-meat markets which were occasionally patronized by *Ny* mill workers. In *In* village there was no fresh-meat market, and there had not been any since the last of February, 1916. In October, 1915, a privately operated market was opened in the basement of the company store building. This market was kept open every week day until about January 1, 1916, but, from all accounts, it was poorly managed. For this reason and for the reason that locally produced fresh meats became scarce after January 1, the market was open only one or two days a week during January and February and its credit trade was severely curtailed, being now limited to those households which had been prompt in settlements. In the latter part of February the market ceased to be operated. In the town of Inman, a mile or more from the mill village, there was a market selling fresh meat for cash only, which had a few regular customers among the mill workers. No other market was accessible except in the city of Spartanburg, 13 miles away.

With the exception of a small amount of poultry purchased at home or purchased from near-by farmers, the sole sources of fresh meats in the two villages during the late spring of 1916 were these fresh-meat markets. The difference in availability of a fresh meat supply in the two villages is clearly reflected in the records of actual purchases during the 15-day period May 16-30, 1916, illustrated in Table XI, thereby suggesting a marked contrast in fresh-meat consumption between the two villages for households of similar incomes. (See also Table XIII.)

TABLE XI.—*Comparison of availability of fresh meat as shown by the number of purchases and the average daily supply of this food during the period May 16–30, 1916, in households, with family incomes less than the average, of two mill villages of South Carolina.*

Number of purchases during 15-day period.	Village of *Ny*. (average daily supply per adult male unit, 31.2 grams.)		Village of *In*. (average daily supply per adult male unit, 7.0 grams.)	
	Number of households purchasing.	Per cent of total households.	Number of households purchasing.	Per cent of total households.
None	17	31.0	46	65.8
1	6	10.9	18	25.7
2	7	12.7	4	5.7
3	7	12.7	1	1.4
4	6	10.9	1	1.4
5	6	10.9	0	0.0
More than 5	6	10.9	0	0.0

(3) *Produce from adjacent farm territory.*—The two villages presented a striking contrast with respect to the availability of food supplies from adjacent farm territory.

In the mill village of *In* there were no regular sellers of farm produce during the spring of 1916; farmers visited the village only occasionally and then practically solely in order to dispose of such goods as they had been unable to sell in the near-by town of Inman. The absence of hucksters was so marked that repeated and detailed inquiries were made of mill workers' households and of other persons living in or in close touch with the village, and the village was several times canvassed in order to secure as complete and accurate information as possible in relation thereto. *Ny*, on the other hand, appeared to be a center for marketing produce from near-by farms. In addition to a number of farmers who marketed their produce in that village occasionally, not less than 22 farmers who habitually sold in the village at retail were found and interviewed in a single canvass of the adjacent territory. These regular hucksters came to the village once a week or oftener practically the year round. Of the 22 who were interviewed, 15 sold fresh milk and butter, 10 sold eggs, 7 sold poultry, 5 sold fresh pork, 2 sold fresh beef, and practically all of them sold potatoes and vegetables. Those selling milk and butter delivered regularly throughout the year and marketed other produce in different seasons. Thus, eggs were sold principally in the spring, poultry in the summer, autumn, and winter, fresh beef and pork in the autumn and winter, and green vegetables in the spring, summer, and autumn. On the basis of statements made by those selling produce regularly, not less than 41,000 quarts of fresh milk (about 790 quarts weekly), 12,000 pounds of butter (about 230 pounds weekly), 1,800 dozen eggs, and 4,200 pounds of live poultry, fresh beef, and fresh pork were sold during the 12 months ending May 30, 1916. These totals do not include quantities sold by other farmers or by stores and markets.

This contrast in available sources of farm produce is indicated also by the statements of actual purchases by the households in the respective villages, secured in the course of the dietary canvass. These statements have been summarized for households of similar incomes in Table XII. A striking difference is shown in the extent to which the households in *Ny* and *In* relied upon near-by farms for supplies of certain foods.

TABLE XII.—*Comparison of availability of certain foods in two cotton-mill villages of South Carolina, as indicated by the proportion of the households with family incomes under the average of the contrasted villages purchasing the specified articles from nearby farms during the period May 16–30, 1916.*

Article purchased.	*Ny.*			*In.*		
	Average quantity per household purchasing.	Households purchasing.		Average quantity per household purchasing.	Households purchasing.	
		Number.	Per cent of total households.		Number.	Per cent of total households.
Fresh milk	22.5 qts.	24	51.0	29.3 qts.	3	4.5
Butter	3.4 lbs.	23	49.0	4.0 lbs.	1	1.5
Eggs	2.9 doz.	19	40.5	6.0 doz.	1	1.5
Fresh vegetables	....	31	66.0	....	1	1.5
Fresh fruit	....	8	17.0	....	0	0.0
Poultry	4.0 lbs.	1	2.1	3.0 lbs.	1	1.5
Any of the above articles	....	40	83.3	....	6	9.0
None	....	8	16.7	....	61	91.0

The difference between *Ny* and *In* in availability of food supplies from adjacent farm territority was so pronounced that further inquiries were made into some of the underlying conditions in order to discover, if possible, what other economic factors were responsible for bringing this about. From these inquiries it appeared that at least two conditions were important in causing the difference in availability of the supply of the foods in question: namely (*a*) differences in the kind of agriculture in the territory adjacent to the villages, and (*b*) differences in marketing conditions. The two are closely related, but for the sake of clearness it will be advantageous to discuss them separately.

(*a*) Contrast in the kinds of agriculture near the two villages.—A census of the farm products in the agricultural territory adjacent to the two villages was not undertaken, but from observation in the course of several trips and canvasses in the sections in question it was quite clear that a marked contrast existed in the kinds of agriculture pursued. The territory around *In* was planted principally in cotton, and relatively little diversification in crops existed. Truck farming on any considerable scale was not engaged in. Few beef cattle were raised and milch cows apparently were usually not more than sufficient to supply the household needs of the farmers. Many farmers had no cows or pigs or even poultry. The agriculture in the *In* section seemed rather typical of the cotton areas in South Carolina. Cotton was the predominant crop; all other products were incidental, none of them constituting the principal output of any farm, so far as was observed. The territory around *Ny*, on the other hand, was exceptional for South Carolina in that a considerable amount of diversified farming was carried on, although not fully comparable in this respect with the farming sections in States where one-crop agriculture has not been the rule. Cotton was a relatively less important crop, and beef cattle, swine, poultry, and milch cows seemed much more abundant than in the *In* section. Apparently greater emphasis was given to gardens, and the amount of truck produced was noticeably larger. The physical character of the section apparently was one cause of this difference in products. The land around *In* is almost level, lies well below the foothills of the Blue Ridge Mountains, and is well suited for the growing of cotton. The land around *Ny* is quite rolling and even hilly, being, in fact, in the foothills of the mountains and thus not so well suited to cotton growing. Land not suitable for the cultivation of cotton and, hence, available and used for corn and truck products was consequently far more abundant near *Ny* than near *In*.

(*b*) Contrast in market conditions.—Conditions affecting the market for farm produce from the two sections were quite different in some important respects. The village of *Ny* is itself more isolated than the village of *In* and is not near any important community. The nearest railway station is a mile away and is surrounded by only about a dozen houses, including three small stores. Seneca, the nearest town of any size (population 1,313 in 1910), is some 4 miles from *Ny*, and Greenville, the nearest city (population 15,741 in 1910), is about 40 miles distant. Seneca exports comparatively little produce and hence its market is limited to local needs which are not sufficient to absorb all the miscellaneous farm products of the vicinity. *Ny* is thus a competitor for such produce as the adjacent farm territory affords. The village itself has been in existence without much change in size for about 25 years, and we found that some of the sellers of farm produce had been visiting it regularly for over 10 years. On the other hand, *In* mill village is almost on the outskirts of the town of Inman (population 474 in 1910), which is on the railroad connecting Spartanburg, S. C., with Asheville, N. C. The demands of the Inman market for farm products are far from being confined to securing sufficient supplies for the needs of its townspeople, since several resident buyers purchase the surplus produce of the adjacent territory and ship it to Spartanburg. Since Spartanburg (population 17,517 in 1910) is but 13 miles distant along a good highway, buyers from that city cover the territory around *In* village fairly thoroughly, and farmers having produce to market often take it to the city when they go there to avail themselves of Spartanburg's superior shopping advantages. The position of *In* village appears, therefore, to be distinctly disadvantageous with respect to farm produce since it must compete for this not only with the town of Inman but, more important, also with the city of

Spartanburg. So far as could be ascertained in 1916, no regular trade with near-by farms had been established, and, as has been pointed out, such casual trade as existed was only that afforded by occasional visits of hucksters who, after making the rounds in the town of Inman, had unsold remnants of produce.

(4) *Home-provided foods.*—Specific inquiries were made of all mill workers' households regarding their possession of cows, poultry, and gardens and, as far as practicable, regarding their importance particularly during the spring of 1916. Different proportions of the households in the two villages were found to have such sources of food supplies.

(*a*) Milch cows.—There was but little difference in the proportion of households in either village owning productive cows during the spring of 1916, the percentage being 17.2 for *Ny* and 23.3 for *In* among households having less than the average income. Such difference as existed in this respect was in favor of *In*. But it should be noted in this connection that 33.3 per cent of the *In* households had no fresh-milk supply at all during the 15-day period for which household supply records were kept, as against only 8 per cent of the *Ny* households (see Table XIV). This difference in distribution was caused by the larger proportion of *Ny* households that purchased milk from hucksters, since, as shown in Table XII, 51 per cent of *Ny* households purchased fresh milk from hucksters as against 4.5 per cent of *In* households.

(*b*) Swine.—Slaughtering of hogs is done in autumn and winter. This is a general practice and prevailed in *Ny* as well as in *In*. Home-produced pork did not figure in the spring food supply of mill workers' households in either village, except in the form of cured and salt meat. Of the *Ny* households, 17 per cent slaughtered home-raised hogs as compared with 33.3 per cent of *In* households. All of these households slaughtered their hogs before February 1, 1916, the majority in either village slaughtering before Christmas, 1915. Of the *Ny* households, 11 per cent cured home-slaughtered meat, as compared with 29 per cent of *In* households; but very little of this meat was on hand for use in the late spring. Inquiries of households slaughtering swine revealed the fact that in less than 5 per cent of such households were there any supplies of home-cured pork on hand on May 16, 1916, these being principally salt pork. The home-produced pork, therefore, did not appear to enter in significant degree into the spring food supply of the households in either village.

(*c*) Poultry.—Inquiries of households having less than the average income showed that 40 per cent of the *Ny* households and 25 per cent of the *In* households either did own poultry during the winter and spring months ending May 30, 1916, or were owning poultry at the time of the canvass (from June 1 to June 10, 1916). The average number of poultry consumed per household during the preceding year was 22 in *Ny* and 8 in *In.* The per cent of *Ny* households reporting consumption of home-owned poultry during the spring of 1916 was 19, as against 3 per cent for *In.* Thirty-two per cent of *Ny* households reported a fairly regular supply of eggs from home-owned hens as against 21 per cent of *In* households. It appears that the advantage in the supplies of home-produced poultry and eggs during the preceding winter and spring lay distinctly with *Ny* households.

(*d*) Gardens.—Home gardens were much more generally found in the village of *In* than in *Ny.* Nearly 92 per cent of the *In* households had gardens planted on June 1, 1916, as against less than 23 per cent of *Ny* households. The opportunity afforded by suitable garden space was decidedly better in *In* than in *Ny;* practically every home in *In* had a good-sized garden plot, whereas many of the *Ny* households had no suitable space at all.

It was quite evident, however, that home gardens contributed but very slightly, if at all, to the food supply of households in either village during the spring of 1916. With the exception of an occasional ("rare" is perhaps a more accurate term) "mess" or dish of greens, a very little lettuce, and a few young onions, the gardens had yielded no supplies during 1916 up to about June 1. Not until after June 15 did garden produce become abundant, a condition that was somewhat contrary to the expectation of the authors, who had anticipated finding considerably earlier garden production in this section. The principal reason for this tardiness appears to be the fact that gardens in mill villages are usually planted later than gardens elsewhere in this section. Difficulty in getting the ground prepared early enough, owing in part to the fact that the long hours of work in the mill leave no available daylight for gardening until well along in the spring, lack of initiative in making other preparations, and possibly other causes, apparently almost preclude good early spring gardens in most of the mill villages studied, including *Ny* and *In,* although climatic conditions ordinarily are such that gardens can be made to yield supplies of early varieties of vegetables during May and even in April. Aside from a half dozen households reporting that they had had radishes, lettuce, or English peas, only about one-third of the *In* households reported that they had had greens or young onions even occasionally and in small quantities before this date. In *Ny* the proportion was even less.

Summing up the principal differences in availablilty of food supplies during the spring of 1916 as between *Ny* and *In,* it may be said that (1) supplies of fresh milk, butter, green vegetables, and fresh fruit were available to a greater degree (better distributed among the households) in *Ny* than in *In*, because, in the farm territory adjacent to *Ny*, there was a larger production of these articles of food and because *Ny* occupied a more advantageous location as a market for such products, and (2) that a supply of fresh meat was available to a greater degree in *Ny* than in *In* because of the existence of a fresh-meat market in *Ny* all the year around. In practically all other respects the availability of food supplies appeared to be generally similar in the two villages.

The conditions outlined above are reflected in a comparison of the total food supplies during the 15-day period May 16–30, 1916, of households in *Ny* and *In*. In this comparison (Tables XIII and XIV) in order to eliminate as far as practicable the influence of differences in economic status, only those households with less than the average of incomes[21] have been considered.

In Table XIII is shown the average quantity of each article of food for all the households considered. Inasmuch as an "average" affords no idea of the vitally important factor of distribution, we have prepared Table XIV in which are shown the percentages of the households in each village which had various quantities of each article of food, such quantities being expressed in terms of the average for all households in order to shorten the statistical presentation. The two tables should be considered together in comparing the supplies of any article of food.

This comparison indicates that during the 15-day period, May 16–30, 1916, (1) supplies of fresh meat, fresh milk, green vegetables, and fresh fruit were more abundant (i. e., better distributed) in *Ny* than in *In* households; (2) supplies of cured and canned meats, salt pork, butter, flour, lard, and lard substitutes, and dried peas and beans in *Ny* households were quite similar to those in *In* households; and (3) supplies of eggs, corn meal, Irish potatoes, and most canned goods were more abundant in *In* than in *Ny* households. Other differences in the supplies of articles of food occurring either rarely or in small quantities are indicated.

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[21] The average half-month family income per adult male unit for all households in *Ny* and *In* was $7.99. Hence all households with such incomes under $8 were considered.

TABLE XIII.—*Approximate average daily supply of various foods in households of cotton-mill operatives during the 15-day period May 16–30, 1916, compared for the villages of Ny and In, South Carolina.*

[All households considered have incomes of less than the average of the total households of both villages (less than $8 per adult male unit during the 15-day period).]

Article of food.	Average supply per adult male unit in grams per day.		Ratio of supply of *In* to *Ny* households.
	Ny.[a]	*In*.[b]	
Fresh meats	34	7	0.21
Cured lean meats	24	20	.83
Canned meats	19	17	.89
Eggs	34	50	1.47
Fresh milk	426	457	1.07
Preserved milk	1	3	3.00
Butter	26	30	1.15
Cheese	3	(c)	....
Dried peas and beans	32	25	.78
Canned peas and beans	2	4	2.00
Wheat flour	358	358	1.00
Wheat bread, cakes, and crackers	13	18	1.38
Corn meal	139	180	1.30
Grits	4	2	.50
Canned corn	3	6	2.00
Rice	4	5	1.25
Salt pork	54	53	.98
Lard and lard substitutes	41	40	.98
Green string beans	11	1	.09
Canned string beans	1	4	4.00
Green vegetables	88	46	.52
Canned vegetables	36	36	1.00
Fresh fruits	40	20	.50
Dried fruits	12	8	.67
Canned fruits	10	20	2.00
Irish potatoes	34	60	1.76
Raw sweet potatoes	0	0	....
Canned sweet potatoes	5	3	.60
Sugar	46	39	.85
Sirup	17	17	1.00
Jellies and jams	3	9	3.00
All other foods (cost in cents)	2	1	.50

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[a] 48 households composed of 210.3 adult male units. Data were available for the following number of adult male units for the foods specified; Salt pork and dried fruits, 206.2; Irish potatoes, 205.7; wheat flour, 160.2; corn meal, 204.0.

[b] 67 households composed of 287.4 adult male units. Data were available for the ollowing number of adult male units for the foods specified: Fresh milk and butter, 257.4.

[c] Less than 0.5 gram.

TABLE XIV.—*Percentages of cotton-mill operatives' households having supplies of various articles of food in different quantities per adult male unit per day, compared for the mill villages of Ny and In, South Carolina.*

[All households considered have incomes of less than the average for the two villages.]

Article of food.	Village.	Average daily supply per adult male unit.	Per cent of households whose average daily supply per adult male unit was—			
			None.	Some, but less than one-third of the average of all households.	One-third or more, but less than the average of all households.	The average or more than the average of all households.
		Grams.				
Fresh meats	*Ny*	34	31.2	6.2	16.7	45.8
	In	7	67.2	10.4	13.4	9.0
Cured lean meats	*Ny*	24	37.5	4.2	27.1	31.2
	In	20	46.3	6.0	14.9	32.8
Canned meats	*Ny*	19	22.9	10.4	37.5	29.2
	In	17	35.8	3.0	31.3	29.9
Eggs	*Ny*	34	31.2	4.2	31.2	33.3
	In	50	7.5	6.0	26.9	59.7
Fresh milk	*Ny*	426	8.3	10.4	45.8	35.4
	In	457	33.3	0.0	30.2	36.5
Preserved milk	*Ny*	1	87.5	2.1	2.1	8.3
	In	3	73.6	1.5	1.5	22.4
Butter	*Ny*	26	16.7	10.4	33.3	39.6
	In	30	14.9	16.4	21.4	46.3
Cheese	*Ny*	3	87.5	2.1	0.0	10.4
	In	(a)	97.0	0.0	0.0	3.0
Dried peas and beans	*Ny*	32	25.0	14.6	20.8	39.6
	In	25	32.8	7.5	29.9	29.9
Canned peas and beans	*Ny*	2	83.3	0.0	0.0	16.7
	In	4	85.1	0.0	0.0	14.9
Wheat flour	*Ny*	358	6.2	0.0	43.7	29.2
	In	358	18.5	3.1	32.3	46.2
Wheat bread, cakes, and crackers	*Ny*	13	18.7	12.5	33.3	35.4
	In	18	25.4	6.0	22.4	46.3
Cornmeal	*Ny*	139	29.8	4.3	29.8	36.2
	In	180	20.9	0.0	17.9	61.2
Grits	*Ny*	4	87.5	0.0	0.0	12.5
	In	2	95.6	0.0	0.0	4.5
Rice	*Ny*	4	75.0	0.0	0.0	25.0
	In	5	70.2	0.0	0.0	29.9
Salt pork	*Ny*	54	4.3	4.3	57.2	34.0
	In	53	10.4	0.0	41.8	47.8
Lard and lard substitutes	*Ny*	41	6.2	4.2	52.1	37.5
	In	40	10.4	3.0	37.3	49.3
Green string beans	*Ny*	11	68.7	0.0	0.0	31.2
	In	1	100.0	0.0	0.0	0.0
Canned string beans	*Ny*	1	97.9	0.0	0.0	2.1
	In	4	89.5	0.0	0.0	10.5
Green vegetables (bought)	*Ny*	88	14.6	12.5	39.6	33.3
	In	46	22.7	16.7	37.9	22.7
Other canned vegetables	*Ny*	36	29.2	2.1	22.9	45.8
	In	36	26.9	7.5	28.4	37.3
Fresh fruits	*Ny*	40	25.0	10.4	20.8	43.7
	In	20	43.9	9.1	28.8	18.2
Dried fruits	*Ny*	12	53.2	0.0	17.0	29.8
	In	8	70.2	1.5	6.0	22.4
Canned fruits	*Ny*	10	66.7	0.0	2.1	31.2
	In	20	56.7	0.0	1.5	41.8
Irish potatoes	*Ny*	34	45.8	4.2	20.8	29.2
	In	60	53.7	3.0	3.0	40.3
Fresh sweet potatoes	*Ny*	0	0.0	0.0	0.0	0.0
	In	0	0.0	0.0	0.0	0.0
Canned sweet potatoes	*Ny*	5	81.2	0.0	0.0	18.7
	In	3	88.1	0.0	0.0	11.9
Sugar	*Ny*	46	10.4	4.2	45.8	39.6
	In	39	9.0	9.0	43.3	38.8
Sirup	*Ny*	17	68.7	0.0	2.1	29.2
	In	17	64.2	0.0	0.0	35.8
Jellies and jams	*Ny*	3	70.2	0.0	4.3	25.5
	In	9	40.3	1.5	0.0	58.2

[a] Less than 0.5 gram.

From the foregoing considerations it clearly appears that the character of the household food supply in the two villages was considerably influenced by the availability of certain foods, notably fresh meats, fresh milk, green vegetables, and fresh fruits, all of which were relatively less abundant or less equally distributed in *In* than in *Ny*. It is clear also that these differences in the food supply of *Ny* and *In* households are quite similar to the differences which, as already reported, we found to exist in the food supply of nonpellagrous and of pellagrous households.[22]

We have here, therefore, a striking and significant correspondence between the differences in the availability of certain foods (and thus, it is permissible to assume, in the character of the diet) in the two villages, on the one hand, and the difference with respect to the incidence of pellagra among their households on the other. Since between these two villages no other differences to which significance could properly be attached were disclosed by our study, the conclusion would seem to be warranted that the difference in the availability of food supplies above summarized was the outstanding determining factor in relation to the marked difference in the incidence of the disease.

Thus, of all the factors we have studied in relation to differences in pellagra incidence among our villages, the factor of food availability is the only one in connection with which significant evidence of such relationship was found. The conclusion would, therefore, seem to be warranted that in this factor we have the explanation for the differences among the villages studied in the incidence of the disease, so far as this incidence was a reflection of community conditions.[23]

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[22] Goldberger, Wheeler, and Sydenstricker, 1918: also 1920*a*.

[23] If such factor as food availability operated to effect the rate of pellagra incidence in our villages, then it may be reasonably expected that in the locality with exceptionally unfavorable conditions of food availability, family income would be less efficient as a protective factor than in other similar localities with better conditions of food availability. With a view of testing this we prepared the following table, in which the pellagra incidence rate for each of our income classes of *In* village in which, we believed food availability conditions were least favorable, is compared with that of a group of five villages in which conditions in respect to food availability are believed to have been better. It may be seen that (1) the incidence rate in those income groups in which a significant number of cases occurred was decidedly higher in *In* village: and (2) that the curve of incidence shows a highly suggestive tendency to extend to a higher plane of income in *In* village than in the group of five villages. The indications thus afforded would, therefore, appear to be consistent with and to bear out the assumption which the table was prepared to test.

Pellagra incidence according to family income in In mill village compared with that in a group of five[a] other mill villages of South Carolina during 1916.

[Rate per 1,000 of population classified according to a half-month's family income per adult male unit in May or June, 1916. Only definite cases of pellagra with onset after a residence of not less than 30 days in specified village or in a member of group considered.]

Income group.	Number of persons.		Number of pellagrins.		Rate per 1,000 of population.	
	In	Five other villages.	*In*	Five other villages.	*In*	Five other villages.
All incomes	651	2,785	43	53	66	19
Under $6	266	856	27	29	102	34
$6-$7.99	167	730	10	15	60	21
$8-$9.99	118	506	5	6	42	12
$10-$13.99	74	499	1	2	14	4
$14 and over	26	194	0	1	0	5

[a] Village *Ny* not considered, no pellagra, as above restricted, having occurred in 1916.

IV. DISCUSSION.

From the data presented in the foregoing pages it is evident that a variety of factors of an economic nature, through their effect on the character of the household diet, had an important influence on the incidence of pellagra in the communities studied. Among these factors family income and food availability stand out most conspicuously.

As has been seen, the data presented reveal a very marked inverse correlation between family income and the incidence of the disease. When it is recalled that the range of income enjoyed by our families was small (see pp. 2683, 2685), that the amount of income of even the highest of our income classes was actually quite low (but few had annual incomes of over $1,000), the reduction of incidence to the point of practical disappearance of the disease in this income class is all the more striking and significant. It would seem quite impressively to indicate that the occasional occurrence of the disease in well-to-do individuals must be regarded as a relatively quite exceptional occurrence, and that the explanation of such occurrence must be sought in circumstances of a special or exceptional character.

Cases in the well-to-do, instances of which have been observed repeatedly since the time of Strambio (1796), are of more than ordinary interest because of the perplexity and confusion to which they tend to give rise with respect to the etiology of the disease. Favorable economic status of the individual tends to create the presumption that diet can have little or no etiological significance, since there can be no question of the ability of such individual to provide himself with a liberal diet. Natural as this presumption may be under the circumstances, it nevertheless involves danger of serious error. This results from the implied assumptions that because of financial ability, not only was a satisfactory diet available, but that such was also consumed. Even granting what is not necessarily the case, that financial ability to provide may be assumed to be invariably synonymous with the actual provision of a good diet[24] and that a liberal diet was actually available to the individual, it by no means follows that such diet was in fact consumed. For such assumption would totally ignore the existence of individual likes and dislikes, more or less marked examples of which may be observed at almost any family table.

A great variety of causes may operate to bring about individual peculiarities of taste with respect to food. They may have their origin in the seemingly inherent human prejudice against the new and untried food or dish; they may date from some disagreeable experience associated with a particular food; they may arise as the result of ill-advised, self-imposed, or professionally directed dietary restrictions in the treatment of digestive disturbances, kidney disease, etc.; they may originate as a fad; and in the insane they may arise because of some delusion such as the fear of poisoning, etc.

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[24] In this connection the following from Roussel (1866, pp. 430-431) is of interest: "Almost all the individual histories, found in the literature of pellagra in the well-to-do, are remarkable because of this constant fact * * * namely, that because of some misfortune or by reason of some unwholesome trait (mauvaises habitudes), such as avarice, these well-to-do or wealthy pellagrins subsisted exactly as did the poor pellagrins about them."

The individual peculiarities of taste which may thus arise have a significance in relation to pellagra that has been but little appreciated until recently (Goldberger, 1914 and 1916). In much the greater proportion of a moderate number of cases in well-to-do individuals with a good diet presumably available, coming under our observation, a significant eccentricity in diet could readily be determined (unpublished observations). Vedder (1916, pp. 157–160) and Roberts (1920) have reported observations of a similar character. It is of interest to note also that analogous facts have been recorded in connection with beriberi (see Vedder, 1913, pp. 154, 156, 171, 180, 184). Therefore, in seeking to explain cases of pellagra in individuals believed to have a good diet available, this factor must be given due consideration.

With conditions (including labor supply) in the cotton-milling industry substantially stable, family income may, in general, be expected to fluctuate but little from year to year. With conditions unsettled, family income may either fall or rise very considerably; a depression, accompanied by increasing unemployment and, possibly, reductions in wage rates will be reflected in a reduced family income, while industrial prosperity, with a diminution of unemployment and, possibly, increased wage rates, will be reflected in larger family income. In the former event we may have a diminution in family income to the point of inability to provide the family with a proper diet, with a consequent danger of the development of pellagra and thus with a more or less marked rise in the incidence rate of the disease. In the latter event we have the opposite effects, with a tendency to a reduction in or practical disappearance of the disease. In this we have, we believe, an illustration of the manner of operation of one of the most powerful factors in relation to the endemic and epidemic prevalence of the disease. Through its effect on diet, economic status is also an important element in, if not the entire explanation of, the oft repeated observation of the occurrence of a marked increase in the incidence or the development of an epidemic of the disease following on crop failure[25] (Weiss, 1914, p. 327) or other cause of "hard times," as was actually observed in the United States in 1915, following depression consequent on the outbreak of the World War in 1914, and as there is some reason to fear may again be observed in the spring of 1921 if the present depression, especially in the price of cotton and cotton-textile manufacturing, continues.

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[25] It should not be forgotten that overproduction, by glutting the market, may affect family income (of the farmer) as disastrously as may crop failure.

At this juncture it may be well to point out that family income should always be considered in connection with living (food) costs if confusion and error are to be avoided. It is the purchasing power of family income that is significant and not necessarily its absolute amount.

Although economic status (as typified by family income) is, ordinarily, perhaps the most important factor (particularly in industrial communities) in relation to fluctuation in incidence of pellagra in different years,[26] marked changes in food availability conceivably play a similar rôle (particularly in agricultural communities). The reported occurrence, in some localities, of a sharp increase in the prevalence of the disease following an epizootic among swine or cattle (Niederman, Konrad, and Farkas, 1898) or after the loss of these through floods, we believe, is to be explained, in part, at least, in this manner.

The very great importance of food availability in relation to pellagra prevalence seems heretofore not to have been very clearly recognized. Under some corcumstances, as we have shown, this factor may operate notably to affect the character of the diet and thus the incidence of the disesase. Our data dealt with differences in availability between localities of relatively small area, but it is readily conceivable that analogous differences may exist between areas of great extent such as there is reason to believe actually is the case between the northern and southern parts of the United States. This difference is probably an important factor (together with the well-known difference in dietary habit, Sydenstricker, 1915) in the notable inequality in the incidence of the disease in these two sections of the country.

The results of the present study clearly suggest fundamental lines along which efforts looking to the eradication of the disease should be directed, namely, (1) economic, by improvement of economic status (income), and (2) food availability, by improvement in availability of food supplies.

Measures for improving the economic status of those people most subject to the disease, are in the main, outside of the sanitarian's sphere and but little subject to his influence. While much the same may be said to apply to the conditions of food availability, this field is more easily accessible, both directly and indirectly, to his activities and influence. Thus, for instance, by avoiding ill-considered regulations governing milk production he can, negatively at least, favor an adequate supply of this invaluable food. Furthermore, he can and should aid in improving the conditions of food availability by lending his powerful influence in support of and, by cooperating with, the agencies at work in this field, in their efforts to stimulate milk production (particularly through cow ownership) and to induce the farmer to adopt a suitable system of crop diversification.

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[26] We hope to consider the relation of economic status to the course of the disease from year to year in a separate paper.

And in this connection it may perhaps be remarked that certain preliminary observations have created in our minds a rather strong suspicion that the single-crop system as practiced in at least some parts of our southern States, by reason of apparently unfavorable conditions of food supply and of other conditions of an economic character bound up therein, will be found indirectly responsible for much of the pellagra morbidity and mortality with which local agricultural labor is annually afflicted.

Although considerable study will be required to determine definitely the factors responsible for the high incidence of the disease in the rural areas in question, it would, nevertheless, seem to be the part of wisdom to make an earnest effort to improve conditions in the ways suggested above.

V. SUMMARY AND CONCLUSIONS.

1. In the present paper are reported the results of the part of the pellagra study of cotton-mill villages, during 1916, dealing with the relation of conditions of an economic nature to the incidence of pellagra. It is the first reported study in which the degree of the long-recognized association between poverty and pellagra incidence is measured in a definite, purely objective manner.

2. The study was made among the white mill operatives' households in seven typical cotton-mill villages of South Carolina. Pellagra incidence was determined by a systematic, biweekly, house-to-house canvass and search for cases, only active cases being considered. Information relating to household food supply, family income, etc., was secured by enumerators for a sample section of the period April 16 to June 15, assumed to be representative of the season during which the factors favoring the production of pellagra were assumed to be most effective.

3. Family income was made the basis of classification according to economic status, the Atwater scale for food requirements being used for computing the size of families in comparing their incomes.

4. In general, pellagra incidence was found to vary inversely according to family income. As the income fell, the incidence of the disease rose and showed an increasing tendency to affect members of the same family; as the income fell, incidence fell, being reduced almost to the point of practical disappearance in the highest of our income classes, although the income enjoyed by this class was comparatively quite low.

5. The inverse correlation between pellagra incidence and family income depended on the unfavorable effect of low income on the character of the diet; but family income was not the sole factor determining the character of the household diet.

6. Differences in incidence among households of the same income class are attributable to the operation of such factors as tend to determine the amount and proportion of family income available for the purchase of food, the intelligence and ability of the housewife in utilizing the available family income, and to the differences among households with respect to availability of food supplies from such sources as home-owned cows, poultry, gardens, etc.

7. Differences in incidence among villages whose constituent households are economically similar, are attributable to differences among them in availability of food supplies resulting from differences (*a*) in the character of the local markets, (*b*) in the produce from adjacent farm territory, and (*c*) in marketing conditions.

8. The most potent factors influencing pellagra incidence in the villages studied were (*a*) low family income, and (*b*) unfavorable conditions regarding the availability of food supplies, suggesting that under the conditions obtaining in some of these villages in the spring of 1916 many families were without sufficient income to enable them to procure an adequate diet, and that improvement in food availability (particularly of milk and fresh meat) is urgently needed in such localities.

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INSTITUTE ON VENEREAL-DISEASE CONTROL AND SOCIAL HYGIENE.

Washington, D. C., November 22 to December 4, 1920.

With the cooperation of the Interdepartmental Social Hygiene Board and the American Social Hygiene Association, the United States Public Health Service will conduct an Institute on Venereal Disease Control and Social Hygiene in Washington, D. C., November 22 to December 4, 1920. The institute will be held in the New National Museum of the Smithsonian Institution and will immediately precede the All-America Conference on Venereal Diseases, which will meet December 6-11.[1]

Aim of the Institute.

During the years immediately preceding and following the World War, rapid progress has been made in the United States in the control of venereal diseases. This progress has been due to an increase in knowledge and experience and to an increase in the number of persons devoting their time to the many and varied aspects of the problem. Progress has been so rapid that there are many persons employed in one capacity or another in the attack upon venereal diseases who feel keenly a need for more information in the various sciences which have contributed to recent knowledge and experience. Others desire to get into personal contact with those who are recognized as the highest authorities on various scientific and professional phases of the problem.

Medicine, surgery, biology, psychology, and sociology now have much to contribute to the understanding of this most complex health problem, and there are now available, as there have never been before, eminent specialists in these various fields of knowledge from whom instruction may be obtained.

In conducting this institute on venereal disease control it has been the aim of the Public Health Service to organize a staff of instructors comprising the ablest men and women in those subjects related to the control of venereal diseases, so that health officers,

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[1] An account of the All-America Conference on Venereal Diseases, with an outline program, was published in the Public Health Reports September 17, 1920, pp. 2202-2204.